CLAIMS

What is claimed is:

1. A method of preparing a hologram to be used in a system for recording and projection of images in substantially 3-dimensional format, said method comprising the steps of:

producing the reference beam by passing diffuse coherent light from a laser through a first active optical system containing a plurality of image focusing means therein; and

producing the object beam by passing diffuse coherent light from the same laser through a second active optical system containing a plurality of image focusing means therein of the same number and arrangement as the first active optical system, the F-number of each said focusing means of the second active optical system being the same as the F-number of the first active optical system, and each said focusing means of the first optical system, wherein all of the component parts of an equation used for determining the F-number of the second optical system are substantially the same multiples of all of the component parts used for determining the F-number of the first active optical system, respectively, said multiple being equal to the expected magnification of the 3-dimensional image.

2. A method according to claim 1 wherein a movable aperture is made a part of each of said two active optical systems such that the size and shape of the

aperture of the first active optical system is the same as an elemental image of the unmagnified integral photograph and the size and shape of said aperture of the second active optical system is the same as an elemental image of the magnified integral photograph, said movable aperture being placed between the diffuser plate and each of the image focusing means contained in the active optical system and adjacent to the surface of the diffuser plate, and said method comprising the steps of:

positioning said movable aperture in the first active optical system so that it coincides with the position of the first elemental image of the unmagnified integral photograph; and,

positioning said movable aperture in the second active optical system so that it coincides with the position of the first elemental image of the magnified integral photograph; and,

producing the reference beam by passing diffuse coherent light from a laser through the first active optical system; and,

producing the object beam by passing diffuse coherent light from the same laser through the second active optical system; and,

allowing the reference and object beams to impinge upon the photographic plate for a sufficient time to expose the hologram; and,

thereafter, positioning said movable aperture in the first active optical system so that it coincides with the positions of the second elemental image of the unmagnified integral photograph, the third elemental image of the unmagnified integral photograph, the fourth elemental image of the unmagnified

integral photograph, and so on, each positioning of the aperture comprising a step in the process; and,

at the same time, positioning said movable aperture in the second active optical system so that it coincides with the positions of the second elemental image of the magnified integral photograph, the third elemental image of the magnified integral photograph, the fourth elemental image of the magnified integral photograph, and so on, each positioning of said aperture comprising a corresponding simultaneous step in the process; and,

for each corresponding step, produce the reference and object beams and in the same manner as they were produced for the first elemental position; and,

for each corresponding step, expose the same hologram in the same manner as it was in the previous steps, making sure that both apertures always move together.

3. A method according to claim 2 wherein short bursts of low intensity laser radiation are used as the source of coherent light for exposure of the hologram.

4. A method according to claim 2 wherein a third movable aperture is placed in contact with the emulsion of the photographic plate that is to become the hologram and wherein a fourth movable aperture is placed on the opposite side of the photographic plate that is to become the hologram, so that the both the third and fourth apertures are always positioned coincidentally so as to permit the maximum amount of light to pass through the photographic plate, and wherein the third and fourth apertures move together with the first and second apertures in such a manner as to only expose an element of the hologram, said elemental

position corresponding with the positions of the first and second apertures that also always move together.

5. A method according to claim 2 wherein optics to produce a mirror image of each of the elemental images of the integral photograph to be magnified is used in preparing the hologram so that when the magnified integral photograph is produced each elemental image of the magnified integral photograph is the mirror image of its corresponding elemental image of the unmagnified integral photograph but the spatial arrangement of the elemental images of both the unmagnified and magnified integral photographs is the same.

6. A method according to claim 5 wherein the magnification factor is unity.

7. A method according to claim 5 wherein optics to produce the elemental images of the integral photograph to be magnified is used in preparing the hologram so that when the magnified integral photograph is produced each elemental image of the magnified integral photograph is the same as its corresponding elemental image of the unmagnified integral photograph but the spatial arrangement of the elemental images of magnified integral photograph is reversed with respect to the corresponding elemental images of the unmagnified integral photograph.

8. A method according to claim 7 wherein the magnification factor is unity.

9. A method of preparing a hologram to be used for elemental image multiplexing in a system for recording and projection of images in substantially 3-dimensional format, said method comprising the steps of:

positioning a first movable aperture in the unmultiplexed image plane so that it coincides with the position of the first elemental image of the unmultiplexed integral photograph; and,

positioning a second movable aperture in the multiplexed image plane so that it coincides with the position of the first elemental image of the multiplexed integral photograph; and,

producing the reference beam by passing diffuse coherent light from a laser through the first aperture; and,

producing the object beam by passing diffuse coherent light from the same laser through a second aperture; and,

allowing the reference and object beams to impinge upon the photographic plate for a sufficient time to expose the hologram; and,

thereafter, positioning the first movable aperture in the unmultiplexed image plane so that it coincides with the positions of the second elemental image of the unmultiplexed integral photograph, the third elemental image of the unmultiplexed integral photograph, the fourth elemental image of the unmultiplexed integral photograph, and so on, each positioning of the aperture comprising a step in the process; and,

at the same time, positioning the second movable aperture in the multiplexed image plane so that it coincides with the positions of the second elemental image of the multiplexed integral photograph, the third elemental image of the multiplexed integral photograph, the fourth elemental image of the

multiplexed integral photograph, and so on, each positioning of the aperture comprising a corresponding simultaneous step in the process; and,

for each corresponding step, produce the reference and object beams and in the same manner as they were produced for the first elemental position; and,

for each corresponding step, expose the same hologram in the same manner as it was in the previous steps, making sure that both apertures always move together.

10. A method according to claim 9 wherein short bursts of low intensity laser radiation are used as the source of coherent light for exposure of the hologram.

11. A method according to claim 9 wherein a third movable aperture is placed in contact with the emulsion of said photographic plate and wherein a fourth movable aperture is placed on the opposite side of said photographic plate, so that the both the third and fourth apertures are always positioned coincidentally so as to permit the maximum amount of light to pass through the photographic plate, and wherein the third and fourth apertures move together with the first and second apertures in such a manner as to only expose an element of the hologram.

12. A method of preparing a hologram to be used as a front projection holographic screen for reconstructing magnified 3-dimensional images projected from unmagnified integral photographs or holograms, wherein at least three monochromatic laser beams are used to prepare the hologram, such that the three wavelengths of laser light are complementary so as to produce the appearance of white light, said method comprising the steps of:

optically splitting the first monochromatic laser beam into a reference beam and an object beam such that the reference beam has a spherical wavefront that appears to have been generated at a reasonably large distance and the object beam has a cylindrical wavefront that appears to have been generated at a calculated distance (a focal point for that wavelength); and,

exposing a transparent photographic plate with said monochromatic laser light such that the reference beam impinges on the emulsion side of the photographic plate while the object beam impinges on the side opposite from the emulsion, in such a manner wherein the reference beam exposes the entire plane of the photographic plate in all directions, and the object beam results from a line of light that extends across the entire photographic plate in the linear dimension and a distance *f* from the surface of the emulsion, said distance *f* being calculated as the focal length from the required *(F/#)* of the screen focusing elements; and,

repeating the previous two steps for the second monochromatic laser beam such that the line of light exposed by the object beam is adjacent to and parallel to the line of light exposed by the first monochromatic laser, such that the two lines are not coincident; and,

repeating the first two steps for the third monochromatic laser beam such that the line of light exposed by the object beam is adjacent to and parallel to the line of light exposed by the second monochromatic laser, such that it is not coincident with the line produced by either the first or second monochromatic laser; and,

repeating all of the above steps to ultimately form a number of parallel adjacent sets of three adjacent parallel lines produced by the three monochromatic laser beams so that they may repeat in groups of three across the entire photographic plate.

13. A method according to claim 12 wherein the reference and object beams both impinge on the emulsion side of the photographic plate.

14. A method according to claim 13 wherein the side of the photographic plate opposite from the emulsion is non-transparent and reflective.

15. A method according to claim 12 wherein the object beams are repositioned optically between successive exposures of the photographic plate so as to produce parallel lines.

16. A method according to claim 12 wherein the photographic plate is repositioned mechanically between successive exposures of the photographic plate so as to produce parallel lines.

17. A method according to claim 12 wherein the wavelengths of the three monochromatic laser beams can be roughly characterized as red, blue and green, respectively.

18. A method according to claim 12 wherein the wavelengths of the three monochromatic laser beams are all components of a single laser capable of producing white coherent laser light.

19. A method according to claim 18 wherein the laser used is a krypton laser.

20. A method according to claim 18 wherein the reference beam is a spherical wavefront comprised of several or all of the wavelengths produced by the white light laser.

21. A method according to claim 12 wherein the distance that each real image of the line of light used in the object beam is from the photographic emulsion is computed based upon the focal length required for the particular wavelength of monochromatic light used to produce its portion of the hologram.

22. A method according to claim 12 wherein the holograms are produced as identical rectangular tiles, and the theater screen is produced by assembling the tiles.

23. A method of preparing a hologram to be used in a system for recording and projection of images in substantially 3-dimensional format as a high quality holographic imaging system to transfer low abberation and low distortion images, said method comprising the steps of:

passing coherent light emanating from a laser through a first diffusing screen and further passing the resulting scattered coherent light through a standard projection lens that neither magnifies nor demagnifies, wherein the resulting coherent light becomes the reference beam; and,

passing coherent light emanating from the same laser through a second diffusing screen and further passing the resulting scattered coherent light through a high quality lens system specially designed to be abberation and distortion free, wherein the resulting coherent light becomes the object beam; and,

exposing the a photographic plate with both reference and object beams to produce the hologram.

24. A method according to claim 23 wherein the reference and object beam impinge upon opposite sides of a transparent photographic plate to expose the hologram.

25. A method according to claim 23 wherein the reference and object beam impinge upon the same side of a photographic plate to expose the hologram.

26. A method according to claim 25 wherein the reference and object beam impinge upon the emulsion side of a photographic plate to expose the hologram.

27. A method according to claim 26 wherein the side of the photographic plate that is opposite to the emulsion is a non-transparent reflective surface.

28. A method according to claim 23 wherein the hologram is produced as a reflection hologram.

29. A method according to claim 23 wherein the hologram is produced as a transmission hologram.

30. A method of making a hologram capable of reconstructing an image in substantially 3-dimensional format when used with an active optical system containing a plurality of image focusing means therein, said method comprising the steps of:

passing a laser beam through a standard lens so as to produce the reference beam; and,

illuminating an integral photograph using the same laser; and,

projecting said laser illuminated image of the integral photograph onto a diffuser plate so as to produce the object beam; and,

allowing the laser and object beams to pass through an aperture or slit, and impinge together upon the surface of a photographic film or plate for a sufficient time for photographic exposure.

31. A method of making a holographic film strip to be used in a system for recording and projection of images in substantially 3-dimensional format, according to claim 30, wherein said film strip consists of successive holograms each hologram being capable of reconstructing a 2-dimensional real image of an integral photograph.

32. A method of making a holographic film strip according to claim 31 wherein the object beam is formed from the image of an integral photograph, such that the 3-dimensional image that would have been produced by reconstruction of said integral photograph has no vertical parallax, thereby permitting said holographic film strip to be advanced through a projector at constant velocity.

33. A method of preparing a second integral photograph to be used in a system for recording and projection of images in substantially 3-dimensional format, from a first integral photograph wherein said first integral photograph used together with an active optical system consisting of a plurality of image focusing means therein reconstructs a 3-dimensional image that is pseudoscopic, and wherein said second integral photograph used together with an active optical system consisting of a plurality of image focusing means therein reconstructs a 3-dimensional image that is orthoscopic, said method comprising the steps of:

reconstructing a pseudoscopic real image from the first integral photograph using an active optical system consisting of a plurality of image focusing means therein; and,

photographing the pseudoscopic real image onto a photographic film or plate using an identical active optical system consisting of a plurality of image focusing means therein as was used to reconstruct the pseudoscopic real image from said first integral photograph.

34. A method of preparing a hologram to be used in a system for recording and projection of images in substantially 3-dimensional format, from an integral photograph wherein said integral photograph used together with an active optical system consisting of a plurality of image focusing means therein reconstructs a 3-dimensional image that is pseudoscopic, and wherein said hologram reconstructs a 3-dimensional image that is orthoscopic, said method comprising the steps of:

illuminating the integral photograph with coherent radiation from a laser, thereby producing an object beam by reconstructing a pseudoscopic real image from said integral photograph using an active optical system consisting of a plurality of image focusing means therein; and,

producing a reference beam using the same laser as was used to illuminate the integral photograph; and

exposing a photographic plate or film using the reference and object beams so produced.

35. A method of preparing a second hologram to be used in a system for recording and projection of images in substantially 3-dimensional format, from a first

hologram wherein said first hologram reconstructs a 3-dimensional image that is pseudoscopic, and wherein said second hologram reconstructs a 3-dimensional image that is orthoscopic, said method comprising the steps of:

illuminating said first hologram with coherent radiation from a laser, thereby producing an object beam by reconstructing a pseudoscopic real image; and,

producing a reference beam from the same laser as was used to illuminate said first hologram; and

exposing a photographic plate or film using the reference and object beams so produced.